NATIONAL RADIO ASTRONOMY OBSERVATORY

QUARTERLY REPORT

July 1, 1996 - September 30, 1996

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APPENDIX A. PREPRINTS

A. TELESCOPE USAGE

The following telescopes have been scheduled for research and maintenance in the following manner during the third quarter of 1996.

	140 Foot	12 Meter	VLA	VLBA
Scheduled Observing (hrs)	1724.75	649.75	1730.30	874.50
Scheduled Maintenance and Equipment Changes	266.25	859.00	235.10	401.00
Scheduled Tests and Calibration	164.50	699.25	248.70	350.00
Time Lost	99.50	133.75	71.30	58.60
Actual Observing	1625.25	516.00	1659.00	815.90

B. 140-FT OBSERVING PROGRAMS

The following Continuum programs were conducted during this quarter.

No.	Observer(s)	Program
D191	de Pater, I. (Calif., Berkeley) Heiles, C. (Calif., Berkeley) Maddalena, R. Millan, R. (Calif., Berkeley) Wong, M. (Michigan)	Observations of the aftermath of the comet Shoemaker-Levy with Jupiter crash.
R264	Romero, G. (IAR) Cersosimo, J. (Puerto Rico) Azcarate, J. (IAR)	6 cm polarization and flux density measurements of extragalactic radio sources.

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B654	Barnbaum, C. Morris, M. (UCLA) Omont, A. (IAP, Paris)	Observations of OH and H_2O masers associated with the extraordinary star U Equ.
B660	Bania, T. (Boston) Rood, R. (Virginia) Balser, D. Wilson, T. (MPIR, Bonn)	Measurements of the cosmic abundance of ^{3}He.

No.	Observer(s)	Program
B661	Bourke, T. (CFA) Myers, P. (CFA) Robinson, G. (University College, UNSW, Australia) Hyland, H. (Southern Cross University, Australia)	OH Zeeman observations of northern molecular clouds.
B662	Balser, D. Bania, T. (Boston) Huang, M. (Boston) Shah, R. (Virginia) Rood, R. (Virginia) Jackson, J. (Boston)	Measurements of carbon radio recombination line emission in galactic HII regions.
D190	Dickey, J. (Minnesota) Elliot, E. (Minnesota)	A search for OH emission at 18 cm from diffuse molecular clouds.
G352	Goss, W. M. Dubner, G. (Buenos Aires) Reynoso, E. (Buenos Aires) Holdaway, M.	Neutral hydrogen observations toward W50.
G361	Guo, Z. (Penn State) Burrows, D. (Penn State) Nishikida, K. (Penn State)	Observations of x-ray absorbing clouds in Loop I. 21 cm
L319	Lockman, F. J. Murphy, E. (Virginia)	HI mapping of the galactic plane. 21 cm
S399	Shah, R. (Boston) Bania, T. (Boston) Jackson, J. (Boston)	C91 alpha studies of photodissociation regions: density and temperature structure of the partially ionized medium.
S412	Sembach, K. (MIT) Murphy, E. (Virginia)	A search for galactic, neutral hydrogen, high-velocity clouds near PKS 2155-304.
S415	Schloerb, F. P. (Massachusetts) Lovell, A. (Massachusetts) De Vries, C. (Massachusetts) Senay, M. (Massachusetts) Irvine, W. (Massachusetts) Wootten, H. A.	OH radio observations of comets Hale-Bopp and Wirtanen.
W280	Wootten, H. A.	H_2O monitoring in star forming cores in Rho Oph.

The following pulsar programs were conducted during this quarter.

No.	Observer(s)	Program
A118	Arzoumanian, Z. (Cornell) Nice, D. Taylor, J. (Princeton) Taylor, H. (Princeton)	Bimonthly timing of 63 pulsars at 1420 and 1660 MHz.
A132	Arzoumanian, Z. (Cornell) Nice, D.	Monitoring at 575 MHz of the evolution of the PSR B1957+20 eclipsing binary system.
B617	Backer, D. (Calif., Berkeley) Sallmen, S. (Calif., Berkeley) Foster, R. (NRL) Matsakis, D., (NRL)	Pulsar timing array observations at 800 and 1395 MHz.
M386	McKinnon, M. Fisher, J. R.	A 1.3-1.8 GHz polarization model test and timing of young pulsar PSR B1823-13.

C. 12 METER TELESCOPE OBSERVING PROGRAMS

The following line programs were conducted during this quarter.

No.	Observer(s)	Program
B666	Beasley, A. Holdaway, M.	Polarization monitoring at 3 mm.
C296	Clancy, R. T. (Colorado) Sandor, B. (Colorado)	Mars dust storm observations.
C307	Clancy, R. T. (Colorado) Sandor, B. (Colorado)	Mars/Earth studies.
D192	Dickens, J. (Massachusetts) Irvine, W. (Massachusetts) Ohishi, M. (Nobeyama Obs) Hjalmarson, A. (Chalmers, Onsala) Ikeda, M. (Nobeyama Obs)	The hydrogenation of interstellar molecules: a survey for methylamine.
D193	Dickel, J. (Illinois) Wright, M. (Calif., Berkeley) Rudnick, L. (Minnesota) Dickel, H. (Illinois)	Study of the radio spectra of features in Cas A.
G349	Gonzalez, R. (Calif., Berkeley) Graham, J. (Calif., Berkeley) Helfer, T. (Maryland)	On-the-fly CO mapping of M99.

No.	Observer(s)	Program
G359	Walker, C. K. (Arizona) Bieging, J. (Arizona)	Spectropolarimetry of AGB stars and protostars: confirming a first polarization detection toward IRC+10216.
H318	Holdaway, M.	Verification of 3 mm continuum fluxes of bright quasars.
H322	Hunter, D. (Lowell Obs) Walker, C. E. (Arizona) Wilcots, E. (Wisconsin)	Molecular gas in the extended HI around the irregular galaxy NGC 4449.
J129	Jewell, P. (Royal Obs) Walker, C. K. (Arizona) Glenn, J. (Arizona)	A study of SiO masers in evolved stars—polarization properties.
M403	Mauersberger, R. (Arizona) Henkel, C. (MPIR, Bonn) Chin, Y. (Bonn U.) Langer, N. (MPIfEP, Garching)	Study of interstellar CS: $^{12}C/^{13}C$ and $^{34}S/^{33}S$ ratios.
W345	Walker, C. K. (Arizona) Jewell, P. (Royal Obs) Narayanan, G. (Arizona) Glenn, J. (Arizona)	An experiment to detect linear polarization of mm emission lines.
W363	Wannier, P. (JPL) Andersson, B. (JPL) Moriarty-Schieven, G. (Royal Obs)	An unusual, dusty ring in Perseus: CO observations.
W367	Wyckoff, S. (Arizona State) Ziurys, L. (Arizona State) Kleine, M. (Arizona State) Wehinger, P. (Arizona State)	2 mm spectral-line survey of Comet Hale-Bopp (150-170 GHz).
W370	Wyckoff, S. (Arizona State) Kleine, M. (Arizona State) Wehinger, P. (Arizona State) Ziurys, L. (Arizona State)	$^{12}C/^{13}C$ ratios in molecular clouds from CN: chemical processing.
W373	Woodney, L. (Maryland) A'Hearn, M. (Maryland) Samarasinha, N. (KPNO-NOAO) McMullin, J. (Arizona) Mundy, L. (Maryland)	Monitoring the activity of Comet Hale-Bopp (C/1995 O1).
W380	Woodney, L. (Maryland) A'Hearn, M. (Maryland) McMullin, J. (Arizona) Samarasinha, N. (KPNO-NOAO)	Study of sulfur chemistry in Comet Hale-Bopp (C/1995 O1).
W382	Womack, M. (Penn State) Festou, M. (Midi-Pyrenees Obs) Mangum, J. Stern, A. (SWRI)	Study of CO, H_2CO, CH_3OH, and HCN in Comet C/1995 O1 (Hale-Bopp).

No.	Observer(s)	Program
Z134	Zhou, S. (Illinois) Choi, M. (Texas) Evans, N. (Texas)	$C^{18}O$ J = 2–1 survey of selected regions in Taurus.

D. VERY LARGE ARRAY OBSERVING PROGRAM

Third quarter, 1996 was spent in the following configurations: D configuration from July 1 to September 30.

The following 101 research programs were conducted with the VLA during this quarter:

No.	Observer(s)	Program
AA195	Alexander, P. (Cambridge) Clemens, M. (Cambridge) Green, D. (Cambridge)	Efficient ram-pressure stripping in close galaxy pairs. 20 cm
AA198	Anglada, G. (Mexico/UNAM) Sepulveda, I. (Barcelona) Torrelles, J. (IAA, Andalucia) Rodriguez, L. (Mexico/UNAM) Yang, J. (Nobeyama Obs)	Powering source of L1287 outflow: deeply embedded object or FU Ori Star. 1.3 cm line
AA199	Andre, P. (CNRS, France) Motte, F. (CNRS, France) Bontemps, S. (CNRS, France) Bernard, J-P. (Paris Obs)	Nature of newly discovered cold protostellar clumps. 3.6 cm
AA200	Arnal, M. (IAR) Rodriguez, L. (Mexico/UNAM)	Anisotropic winds in WR stars. 3.6 cm
AB705	Burke, B. (MIT) Becker, D. (MIT) Lehar, J. (CFA) Hewitt, J. (MIT) Roberts, D. (Brandeis)	Time delay of the gravitational lens 0957+561. 3.6, 6 cm
AB766	Blundell, K. (Oxford) Rawlings, S. (Oxford) Lacy, M. (Oxford) Littlewood, C. (Oxford) Willott, C. (Oxford) Serjeant, S. (Imperial College)	The evolution of radio quasars and their environments from z = 0.5-3. 3.6, 6 cm
AB774	Beck, R. (MPIR, Bonn) Hoernes, P. (MPIR, Bonn)	Magnetic arms in NGC 6946. 3.6 cm
AB775	Beck, R. (MPIR, Bonn) Shoutenkov, V. (Lebedev) Shukurov, A. (Moscow/SSAI) Sokoloff, D. (Moscow/SSAI)	Magnetic fields in barred galaxies. 3.6, 6 cm

No.	Observer(s)	Program
AB780	Bridle, A. Perley, R. Swain, M. (Cornell)	Fully sampled imaging of the lobes of 3C 219. 2, 3.6 cm
AB785	Bourke, T. (CFA) Myers, P. (CFA)	OH Zeeman observations of S88B. 20 cm line
AB787	Bastian, T. Chiuderi-Drago, F. (Florence) Alissandrikis, C. (Athens)	Search for linearly polarized radiation over solar active regions. 3.6, 6 cm line
AB789	Bujarrabal, V. (Yebes Obs) Alcolea, J. (Yebes Obs)	M1-92, Minkowski's footprint. 1.3 cm
AB790	Benz, A. (SFIT, ETH) Krucker, S. (SFIT, ETH) Bastian, T. Keller, C. (AURA) Harrison, R. (RAL, UK)	Chromospheric and coronal changes above the network of the quiet sun. 1.3, 2, 3.6, 6 cm
AB791	Balcells, M. (Groningen/Kapteyn) van Gorkom, J. (Columbia) Sancisi, R. (Groningen/Kapteyn)	Accreting HI on NGC 3656. 20 cm line
AB792	Brown, A. (Colorado/JILA) Ambruster, C. (Villanova) Jeffries, R. (Birmingham) Bromage, G. (Lancashire)	Correlation between stellar radio emission and rotation. 2, 3.6, 6, 20 cm
AB793	Brown, A. (Colorado/JILA) Drake, S. (NASA/GSFC) Jones, K. (Queensland) Ayres, T. (Colorado/JILA)	Multiwavelength study of flaring and coronal structure on HR 1099. 2, 3.6, 6, 20 cm
AB794	Balser, D. Bania, T. (Boston) Rood, R. (Virginia) Wilson, T. (MPIR, Bonn)	$^{3}He+$ measurements in planetary nebulae: J320. 3.6 cm line
AB813	Butler, B. Palmer, P. (Chicago)	Detection of OH from Comet Hale-Bopp. 20 cm line
AC308	Condon, J. Cotton, W. Perley, R.	All sky survey. 20 cm
AC431	Capetti, A. (STScI) Zirbel, E. (STScI) Parma, P. (Bologna)	The properties of intermediate luminosity radio galaxies. 6 cm

No.	Observer(s)	Program
AC441	Cotton, W. Swain, M. (Cornell) Bridle, A. Kassim, N. (NRL)	J2146+82—Large radio galaxy with misaligned outbursts. 6, 20, 90 cm
AC459	Cepa, J. (Laguna) del Rio, S. (Laguna) Vila, B. (Nobeyama Obs) Kawabe, R. (NAO, Japan) Brinks, E. (Guanajuato)	Atomic gas in early type galaxies. 20 cm line
AC461	Clarke, T. (Toronto) Kronberg, P. (Toronto) Bohringer, H. (MPIfEP, Garching)	Polarization of radio sources within and behind Abell Clusters. 6, 20 cm
AC463	Carilli, C. Menten, K. (CFA) Reid, M. (CFA) Rupen, M.	Redshifted molecular absorption towards red quasars and gravitational lenses. 0.7, 3.6 cm line
AC465	Crutcher, R. (Illinois) Roberts, D. (Illinois) Troland, T. (Kentucky)	OH Zeeman mapping of NGC 2024. 20 cm line
AC477	Cimatti, A. (Arcetri) Freudling, W. (ESO)	A high redshift radio galaxy. 3.6, 2, 1.3 cm
AD378	Dahlem, M. (STScI)	Extended HI structure of NGC 4666. 20 cm line
AD380	Dubner, G. (IAFE) Cillis, A. (IAFE) Holdaway, M. Kassim, N. (NRL) Mirabel, F. (CNRS, France)	Radio continuum observations in the direction of W50. 20, 90 cm
AD384	DePree, C. (Agnes Scott College) Churchwell, E. (Wisconsin) Goss, W. M.	Continuum observations of the unusual source M17-UC1. 0.7 cm line
AD385	DePree, C. (Agnes Scott College) Churchwell, E. (Wisconsin) Goss, W. M.	H52 alpha observations of G20.08. 0.7 cm line
AD386	DePree, C. (Agnes Scott College) Howard, E. (Rochester) Koerner, D. (JPL)	CS J=1,0 observations of the rotating Torus around K3-50A. 0.7, 1.3 cm line
AF304	Feretti, L. (Bologna) Giovannini, G. (Bologna)	Clusters with possible radio halos. 20 cm
AF318	Florkowski, D. (USNO)	Wolf-Rayet binary HD 192641. 20, 6, 3.6 cm

No.	Observer(s)	Program
AG448	Greenhill, L. (CFA) Henkel, C. (MPIR, Bonn)	Monitoring the acceleration of water megamaser features in NGC 4258. 1.3 cm line
AG449	Gizani, N. (Manchester) Leahy, J. (Manchester) Garrington, S. (Manchester) Perley, R.	Faraday rotation in Hercules A. 3.6 cm
AG458	Guedel, M. (Paul Scherrer Inst.)	Two remarkably active, late F-type stars with widely different ages. 3.6 cm
AG482	Gomez, Y. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM)	H_2CO in MWC349A. 2 cm line
AG484	Gibson, S. (Wisconsin) Holdaway, M. Nordsieck, K. (Wisconsin)	HI mapping of nebular filaments in the Pleiades region. 20 cm line
AG486	Golla, G. (Bochum) Beck, R. (MPIR, Bonn)	Radio halo of NGC 4631: wind or dynamo. 20 cm
AG489	Gopalswamy, N. (Maryland) Kundu, M. (Maryland) Lara, A. (Maryland) Hanaoka, Y. (NAO, Japan) Nitta, N. (Lockheed) Gurman, J. (NASA/GSFC)	Solar filaments using VLA, Nobeyama Radioheliograph, Yohkoh/SXT and SOHO/EIT data. 1.3, 2, 3.6, 6, 20, 90 cm
AG492	Goss, W. M. Cappa, C. (IAR)	HI associated with planetary nebula NRC 2359. 20 cm line
AH571	Huchtmeier, W. (MPIR, Bonn) Westpfahl, D. (NMIMT) Adler, D. (STScI)	CAS 1 and MB 1: a local group member and a merger victim. 20 cm line
AH572	Hjellming, R. Rupen, M.	Radio and x-ray activity in the galactic black hole candidate J1719. 2, 3.6, 6, 20 cm
AH573	Hjellming, R. Rupen, M.	Radio and x-ray activity in the galatic black hole binary GRO J1655. 2, 3.6, 6, 20 cm
AH584	Hunter, D. (Lowell Obs) Wilcots, E. (Wisconsin) van Woerden, H. (Groningen/Kapteyn) Gallagher, J. (Wisconsin)	Gas halo around nearby irregular galaxy Sextans A. 20 cm line
AJ253	Jorsater, S. (Stockholm Obs) Kristen, H. (Stockholm Obs) van Moorsel, G. Lindblad, P. (Stockholm Obs) Broeils, A. (Stockholm Obs)	HI observations of the bright barred spiral galaxies. 20 cm line

No.	Observer(s)	Program
AJ255	Jore, K. (Cornell) Broeils, A. (Stockholm Obs) Haynes, M. (Cornell)	Formation of counter-rotating components in Sa galaxies. 20 cm line
AK376	Kulkarni, S. (Caltech) Frail, D.	Search for the radio counterparts of gamma ray bursters.
AK424	Krause, M. (MPIR, Bonn) Dumke, M. (MPIR, Bonn)	Magnetic field configuration in edge-on spirals NGC 4565 and NGC 5907. 6 cm
AK427	Kassim, N. (NRL)	333 MHz imaging of W44. 90 cm
AK429	Kuiper, T. (JPL) Velusamy, T. (JPL) Langer, W. (JPL)	CCS in protostar L483. 1.3 cm line
AK430	Kawabe, R. (NAO, Japan) Ohta, K. (Kyoto) Yamada, T. (Kyoto) Kohno, K. (NAO, Japan)	CO Imaging of the luminous quasar BR1202-075 at z = 4.7. 0.7 cm line
AL383	Lisenfeld, U. (Arcetri) Alexander, P. (Cambridge) Pooley, G. (Cambridge)	Cosmic ray propagation and the star formation history of galaxies. 3.6, 6 cm
AL384	Lim, J. (SA/IAA, Taiwan) White, S. (Maryland) Cully, S. (Calif., Berkeley)	Radio and x-ray observations of eclipsing binary V471 Tauri. 3.6, 6 cm
AL385	Lacy, M. (Oxford) Rawlings, S. (Oxford) Hughes, D. (Royal Obs) Stevens, R. (Oxford)	Search for CO emission in most distant known radio galaxy. 0.7, 1.3 cm line
AL390	Lee, J. (Maryland) White, S. (Maryland) Kundu, M. (Maryland)	Solar active regions. 2, 3.6, 6 cm
AM466	Mirabel, I. F. (CNRS, France) Duc, P. (CNRS, France) Brinks, E. (Guanajuato)	HI in the merger Arp 105. 20 cm line
AM512	Mirabel, I. F. (CNRS, France) Rodriguez, L. (Mexico/UNAM)	Large scale radio lobes in GRS 1915+105. 2 cm
AM529	Minter, A. Lockman, F. J.	The spatial power spectrum of HI fluctuations. 20 cm line
AM530	Miralles, M. (Massachusetts) Kurtz, S. (Mexico/UNAM)	IRAS 20333+4102: an ultra compact HII region in expansion. 3.6 cm

No.	Observers	Program
AM531	Miralles, M. (Massachusetts) Ho, P. (CFA)	IRAS 18507+0121: a dense core with an unusual line profile. 1.3 cm line
AN070	Nordgren, T. (Cornell) Terzian, Y. (Cornell)	Morphology and kinematics of the possible merger remnant Mrk 266. 20 cm line
AN071	Nordgren, T. (Cornell) Salpeter, E. (Cornell) Terzian, Y. (Cornell) Chengalur, J. (NFRA)	HI morphology and orbital kinematics of galaxy pairs. 20 cm line
AO123	O'Donaghue, A. (St. Lawrence U.) Eilek, J. (NMIMT) Owen, F.	Examining the morphological and dynamical basis for FRI/FRII boundary. 6 cm
AO125	Olling, R. (Columbia)	Determining the shape of dark matter halos from the flaring of HI. 20 cm line
AP332	dePater, I. (Calif., Berkeley)	Jupiter Patrol: aftermath of Comet-Jupiter crash. 20, 90 cm
AP338	Paredes, J. (Barcelona) Marti, J. (CNRS, France) Tavani, M. (Columbia) Peracaula, M. (Barcelona) Kniffen, D. (Hampden-Sydney) Mattox, J. (Maryland)	Simultaneous radio and gamma ray observations of LS I61°303. 2, 3.6 cm
AQ011	Quillen, A. (Ohio State) Yun, M. Kenney, J. (Yale) Pogge, R. (Ohio State)	Barred spirals NGC 2903 and NGC 3351. 2 cm line
AR352	Richer, J. (Cambridge) Chandler, C. (Cambridge)	Thermal SiO emission in molecular outflows. 0.7 cm line
AR354	Reipurth, B. (ESO) Rodriguez, L. (Mexico/UNAM)	Exciting sources of new giant HH flows. 3.6 cm
AR356	Raga, A. (Mexico/UNAM) Reipurth, B. (ESO) Canto, J. (Mexico/UNAM) Rodriguez, L. (Mexico/UNAM)	Exciting source of the "deflected" HH system 270/110. 3.6, 6 cm
AR357	Raulin, J. (Maryland) Gopalswamy, N. (Maryland) Kundu, M. (Maryland) Lara, A. (Maryland) Gurman, J. (NASA/GSFC)	Search for cool material in solar active regions. 6, 20, 90 cm

No.	Observer(s)	Program
AR359	Robinson, B. (Northwestern) Yusef-Zadeh, F. (Northwestern) Roberts, D. (Illinois) Goss, W. M. Uchida, K. (MPIR, Bonn) Green, A. (Sydney)	A search for 1720 MHz OH emission from the galactic center. 20 cm line
AS568	Sramek, R. Weiler, K. (NRL) VanDyk, S. (Calif., Berkeley) Panagia, N. (STScI)	Properties of radio supernovae. 1.3, 2, 3.6, 6, 20 cm
AS586	Schoenmakers, A. (Utrecht) van der Laan, H. (Utrecht) de Bruyn, A. (NFRA) Rottgering, H. (Leiden)	Giant radio galaxy candidates with redshifts above 0.4. 3.6 cm
AS587	Szomoru, A. (Groningen/Kapteyn) van Gorkom, J. (Columbia) Gregg, M. (LLNL)	HI-deficient galaxies at the center of the Bootes void. 20 cm line
AS588	Szomoru, A. (Groningen/Kapteyn) van Gorkom, J. (Columbia) Gregg, M. (LLNL)	Structure of substructure; voids in voids. 20 cm line
AS591	Simpson, C. (Florida Int) Gottesman, S. (Florida)	Evolution of low-mass dwarf galaxies: an HI study. 20 cm line
AT188	Thornley, M. (Maryland) Mundy, L. (Maryland)	Searching for density wave signatures in nearby flocculent galaxies. 20 cm line
AU066	Urbanik, M. (Jagellonian) Klein, U. (Bonn U.) Chyzy, K. (Jagellonian) Beck, R. (MPIR, Bonn)	Magnetic fields in irregular galaxies. 3.6, 6 cm
AV223	Vasquez, R. (IAA, Andalucia) Torrelles, J. (IAA, Andalucia) Lopez, J. (Mexico/UNAM) Miranda, L. (UCM)	Search for BRETs in planetary nebulae. 3.6 cm line
AV226	van Gorkom, J. (Columbia) Carilli, C. Stocke, J. (Colorado/JILA) Shull, J. (Colorado/JILA)	HI environment of nearby Ly α clouds. 20 cm line
AV227	Verdes-Montenegro, L. (IAA, Andalucia) Yun, M. Huchtmeier, W. (MPIR, Bonn) del Olmo, A. (IAA, Andalucia) Perea, J. (IAA, Andalucia)	HI study of Hickson compact group HCG 96. 20 cm line

No.	Observer(s)	Program
AV229	Vasisht, G. (Caltech) Soberman, G. (Caltech) Frail, D.	Search for extended lobes around galactic x-ray transients. 90 cm
AW433	Wootten, H. A. Mangum, J. Torrelles, J. (IAA, Andalucia) Gomez, J. (IAA, Andalucia) Barsony, M. (Calif., Riverside) Hurt, R. (Calif., Riverside)	Structure of the disk(s) of a multiple protostar, S68N. 1.3 cm line
AW436	Wilcots, E. (Wisconsin) Hodge, P. (Washington) Olsen, K. (Washington)	HI mosaic of IC 1613. 20 cm line
AW437	Wyrowski, F. (Koln) Walmsley, C. M. (Koln) Hofner, P. (Koln)	Carbon recombination lines as a probe of the Orion PDR. 3.6 cm line
AW438	Wilson, T. (MPIR, Bonn) Gaume, R. (USNO) Johnston, K. (USNO)	Heating source of Orion-KL nebula. 1.3 cm line
AW440	White, S. (Maryland) Lim, J. (SA/IAA, Taiwan) Aschwanden, M. (Maryland) Kundu, M. (Maryland)	Multi-wavelength campaign for AU Mic. 3.6, 20 cm
AW443	Wiseman, J. Brown, R.	High velocity ionized wind in DR 21. 3.6 cm line
AW449	Willis, T. (DRAO)	A large, amorphous radio source near 3C 380.
AW450	Wilcots, E. (Wisconsin) Hoessel, J. (Wisconsin)	HI in possible Local Group member DDO 187. 20 cm line
AY073	Yun, J. (Lisbon) Moreira, M. (Lisbon) Torrelles, J. (IAA, Andalucia)	Radio continuum sources seen towards Bok globules. 2, 6 cm
AY079	Yun, M.	Continuum sources in the field of distant RG 1202-07. 3.6 cm
AZ081	Zepka, A. (Calif., Berkeley) Lundgren, S. (NRL) Kassim, N. (NRL) Cordes, J. (Cornell) Frail, D.	Search for the supernova remnant of young pulsar J0631+1036. 20, 90 cm
AZ084	Zwaan, M. (Groningen/Kapteyn) Briggs, F. (Groningen/Kapteyn) Sprayberry, D. (Groningen/Kapteyn)	Galaxies with extreme low surface density HI. 20 cm line

No.	Observer(s)	Program
AZ085	Zwaan, M. (Groningen/Kapteyn) Briggs, F. (Groningen/Kapteyn) Sprayberry, D. (Groningen/Kapteyn)	HI selected galaxies from the Arecibo deep strip survey. 20 cm line
AZ086	Zhang, Q. (CFA) Ho, P. (CFA)	HC_3N in infall candidate W51E. 0.7 cm line
BG047	Greenhill, L. (CFA) Koekemoer, A. (Mt. Stromlo) Gwinn, C. (Calif., Santa Barbara) Moran, J. (CFA) Herrnstein, J. (CFA) Henkel, C. (MPIR, Bonn) van Breugel, W. (LLNL) Dey, A. (LLNL)	Ultraluminous water maser emission in an early type galaxy at 100 Mpc. 1.3 cm
BH021	Hough, D. (Trinity U.) Readhead, A. (Caltech)	Lobe-dominated superluminal quasar 3C 245. 2, 3.6, 6 cm
BR034	Roberts, D. (Brandeis) Wardle, J. (Brandeis) Ojha, R. (Brandeis) Homan, D. (Brandeis) Aller, H. (Michigan) Hughes, P. (Michigan)	Sources with rapidly varying polarization. 1.3, 2 cm

E. THE VERY LONG BASELINE ARRAY OBSERVING PROGRAM

The following 42 research programs were conducted with the VLBA this quarter:

No.	Observer(s)	Program
BA007	Alef, W. (MPIR, Bonn) Preuss, E. (MPIR, Bonn) Kellermann, K.	Superluminal motion in the lobe-dominated radio galaxy 3C 390.3. 1.3 cm
BB023	Beasley, A. Conway, J. (Chalmers, Onsala) Dhawan, V. Walker, R. C. Wrobel, J. Patnaik, A. (MPIR, Bonn) Muxlow, T. (Manchester)	VLBA calibrator survey. 3.6 cm
BB056	Blundell, K. (Oxford) Lacy, M. (Oxford) Beasley, A. Walker, R. C.	Parsec scale structure of radio quiet quasars. 3.6 cm with phased VLA

No.	Observer(s)	Program
BB064	Benz, A. (SFIT, ETH) Conway, J. (Chalmers, Onsala) Alef, W. (MPIR, Bonn) Guedel, M. (SFIT, ETH)	Planet search via astrometry of dMe stars. 3.6 cm with phased VLA
BC053	Clark, T. (NASA/GSFC) Ryan, J. (NASA/GSFC) Himwich, W. (Interferometrics) MacMillian, D. (Interferometrics) Gordon, D. (NASA/GSFC) Niell, A. (Haystack) Corey, B. (Haystack) Rogers, A. (Haystack) Eubanks, T. (USNO) Fomalont, E. Walker, R. C.	NASA Space Geodesy Program: geodetic observations for 1996. 3.6 cm
BC054	Coles, W. (Calif., San Diego) Klingesmith, M. (Calif., San Diego) Rickett, B. (Calif., San Diego)	Measurement of solar wind speed near the sun using IPS. 2, 3.6 cm
BC059	Coles, W. (Calif., San Diego) Rickett, B. (Calif., San Diego) Ye, S. (Calif., San Diego) Massey, W. (Calif., San Diego)	Measurement of the solar wind speed near the sun using IPS. 2, 3.6 cm
BD031	Diamond, P. Field, D. (Bristol, UK) Kemball, A. Gray, M. (Bristol, UK) Masheder, M. (Bristol, UK)	Polarization observations of OH masers in star forming regions. 18 cm
BD034	Dhawan, V. Kellermann, K. Romney, J.	3C 84. 0.7 cm with VLA single antenna
BD037	Denn, G. (Iowa) Mutel, R. (Iowa)	Polarized VLB jet of BL Lac. 1.3, 2, 6 cm line
BF015	Fomalont, E. Bradshaw, C. (George Mason) Geldzahler, B. (George Mason)	The parallax of Sco X-1. 6 cm
BG045	Greenhill, L. (CFA) Moran, J. (CFA) Danchi, W. (Calif., Berkeley) Bester, M. (Calif., Berkeley)	Snapshot survey of SiO maser stars at maximum and minimum luminosity. 0.7 cm with VLA Single Antenna

No.	Observer(s)	Program
BG047	Greenhill, L. (CFA) Koekemoer, A. (Mt. Stromlo) Gwinn, C. (Calif., Santa Barbara) Moran, J. (CFA) Herrnstein, J. (CFA) Henkel, C. (MPIR, Bonn) van Breugel, W. (LLNL) Dey, A. (LLNL)	Ultraluminous water maser emission in an early-type galaxy at 100 Mpc. 1.3 cm with phased VLA
BG050	Greenhill, L. (CFA) Chernin, L. (Calif., Berkeley)	Collimation and launch of protostellar outflows. 1.3 cm with VLA single antenna
BG056	Garrett, M. (Manchester) Patnaik, A. (MPIR, Bonn) Nair, S. (Manchester) Porcas, R. (MPIR, Bonn)	Multi-epoch observations of 1830-211 at 15 and 43 GHz. 2 cm
BG059	Guirado, J. (JPL) Gomez, J. (IAA, Andalucia) Marscher, A. (Boston) Alberdi, A. (ESA, Spain) Marcaide, J. (Valencia)	BL Lac object 0735+178. 3.6 cm
BH020	Hagiwara, Y. (Madrid Obs) Kawabe, R. (NAO, Japan) Diamond, P. Kameno, S. (NAO, Japan) Nakai, N. (NAO, Japan) Inoue, M. (NAO, Japan) Kohno, K. (NAO, Japan)	Newly found H_20 megamaser in galaxy NGC 5793. 1.3 cm with phased VLA
BK032	Kemball, A. Taylor, G. Baganoff, F. (UCLA) Vermeulen, R. (NFRA) Pearson, T. (Caltech) Readhead, A. (Caltech)	Intraday variables - simultaneous observations with ROSAT. 6, 18 cm
BK035	Krichbaum, T. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Zensus, J. A. Witzel, A. (MPIR, Bonn)	Motion in the jet and counter-jet of Cygnus A. 1.3 cm
BK037	Kellermann, K. Zensus, J. A. Cohen, M. (Caltech) Vermeulen, R. (Caltech)	Monitoring superluminal sources. 2 cm
BL027	Lestrade, J-F. (Paris Obs) Phillips, R. (Haystack) Jones, D. (JPL) Preston, R. (JPL)	Astrometric monitoring of Sigma2 CrB. 3.6 cm with phased VLA

No.	Observer(s)	Program
BL037	Lobanov, A. (NMIMT) Swain, M. (Cornell)	Compact emission in lobe-dominated quasars. 18 cm
BL038	Lestrade, J-F. (Paris Obs) Phillips, R. (Haystack) Jones, D. (JPL) Preston, R. (JPL)	Search for extrasolar planets by VLBI astrometry. 3.6 cm with phased VLA
BM056	Moran, J. (CFA) Herrnstein, J. (CFA) Greenhill, L. (CFA) Miyoshi, M. (Mizusawa Obs) Inoue, M. (NAO, Japan) Nakai, N. (NAO, Japan) Diamond, P. Henkel, C. (MPIR, Bonn)	The proper motions of the water vapor masers in NGC 4258. 1.3 cm with phased VLA
BM058	Marvel, K. (New Mexico State) Claussen, M. Wootten, H. A. Wilking, B. (Missouri)	Water masers in low luminosity young stellar objects. 1.3 cm with VLA single antenna
BM060	Menten, K. (CFA) Reid, M. (CFA)	Proper motions of SiO masers in the central parsec of the galaxy. 0.7 cm with VLA single antenna
BM063	Marscher, A. (Boston) Gomez, J. (IAA, Andalucia) Wehrle, A. (JPL) Xu, W. (JPL) Georganopoulos, M. (Boston)	Coordinated multiband observations of blazars. 1.3 cm
BN003	Nakai, N. (NAO, Japan) Inoue, M. (NAO, Japan) Miyoshi, M. (Mizusawa Obs) Diamond, P.	H_20 megamaser in the Seyfert galaxy NGC 5506. 1.3 cm with phased VLA
BP031	Preuss, E. (MPIR, Bonn) Alef, W. (MPIR, Bonn) Pauliny-Toth, I. (MPIR, Bonn) Kellermann, K. Gabuzda, D. (Lebedev)	Polarimetry of the FRII radio galaxy 3C 111. 3.6 cm
BR034	Roberts, D. (Brandeis) Wardle, J. (Brandeis) Ojha, R. (Brandeis) Homan, D. (Brandeis) Aller, H. (Michigan) Aller, M. (Michigan) Hughes, P. (Michigan)	Sources with rapidly varying polarization. 1.3, 2 cm

No.	Observer(s)	Program
BR038	Reid, M. (CFA) Readhead, A. (Caltech) Treuhaft, R. (JPL) Vermeulen, R. (Caltech)	Trigonometric parallax to Sgr A*. 0.7 cm
BR040	Ratner, M. (CFA) Bartel, N. (York U.) Lebach, D. (CFA) Lestrade, J-F. (Paris Obs) Shapiro, I. (CFA)	Astrometry of HR 1099 and IM Peg for the Gravity Probe-B mission. 3.6 cm with phased VLA
BR041	Rupen, M. Bartel, N. (York U.) Beasley, A. Conway, J. (Chalmers, Onsala) Bietenholz, M. (York U.) Rius, A. (Barcelona) Altunin, V. (JPL) Jones, D. (JPL) Graham, D. (MPIR, Bonn) Venturi, T. (Bologna) Umana, G. (Bologna)	VLBI imaging of supernova 1993J in M81. 3.6, 6, 18 cm with phased VLA
BS029	Stocke, J. (Colorado/JILA) Rector, T. (Colorado/JILA) Gabuzda, D. (Lebedev)	X-ray loud BL Lacs and AGN unification. 3.6 cm
BS034	Salter, C. (NAIC) Salgado, J. (Michigan) Ghosh, T. (NAIC) Manoharan, P. (TIFR) Junor, W. (New Mexico)	Scattering in the range l = 30 to l = 75. 18, 90 cm
BT021	Tingay, S. (Mt. Stromlo) Jauncey, D. (CSIRO) Reynolds, J. (CSIRO) Tzioumis, A. (CSIRO) Preston, R. (JPL) Meier, D. (JPL) Jones, D. (JPL) Murphy, D. (JPL) Lovell, J. (Tasmania) McCulloch, P. (Tasmania) Costa, M. (Tasmania)	Short time scale monitoring of Centaurus A at 8.4 GHz. 3.6 cm
BT022	Taylor, G. Vermeulen, R. (NFRA)	Measuring absolute motions in the bi-directional jets of 1946+708. 2, 3.6 cm
BT023	Taylor, G. Readhead, A. (Caltech) Pearson, T. (Caltech)	Five compact symmetric objects from the PR sample. 0.7 cm

No.	Observer(s)	Program
BV019	Vermeulen, R. (Caltech) Taylor, G. Browne, I. (Manchester) Henstock, D. (Manchester) Pearson, T. (Caltech) Readhead, A. (Caltech) Wilkinson, P. (Manchester)	Caltech-Jodrell snapshot survey of superluminal motion. 6 cm
BW025	Walker, R. C. Fomalont, E.	VLBA Baselines—service/test project. 3.6 cm
BW027	Wilkinson, P. (Manchester) Augusto, P. (Manchester) Browne, I. (Manchester)	Resolved flat spectrum radio sources. 6cm with VLA single antenna

F. SCIENCE HIGHLIGHTS

Socorro

FIRST Survey Assists Optical Identification of 25,000 Radio Sources - An optical identification program for radio sources catalogued by the FIRST survey based on automated plate measuring machine scans of the Palomar Observatory Sky Survey (POSS I) plates has yielded optical counterparts for 25,000 radio sources. This project will immediately provide samples of various radio source populations from one to three orders of magnitude larger than those in existence, and will advance significantly our knowledge of the radio universe. Because the positions of unresolved FIRST sources are known to a level of precision unprecedented for such a high-surface-density catalog, FIRST becomes a useful astrometric calibration standard. FIRST source positions are being used to calibrate and correct the astrometry errors, plate-to-plate shifts and the offset of the reference frame in the automated plate machine measurements of the POSS I plates.

Investigators: R. McMahon (Cambridge), R. White (STScI), R.Becker (UC Davis), and D Helfand (Columbia)

Transcontinental Pulsar Observations Study Crab's Giant Pulses - An experimental observation using the VLA and an 85-foot telescope at Green Bank provided information on the broadband spectrum of the giant pulses in the Crab pulsar. The phased VLA observed the Crab at 1400 MHz and the 85-foot telescope observed it at 610 MHz. A trigger pulse was sent from the VLA to Green Bank using a socket link on the Internet. The typical Internet delay of 200 ms was less than the dispersion delay between 1400 MHz and 610 MHz. The results showed high correlation of the events at both frequencies. The broad spectrum of the pulses supports models of a small radiating unit that delivers a nanosecond-wide pulse.

Investigators: D. Backer (UC Berkeley), T. Hankins (NMIMT), D. Moffett (NMIMT), S. Lundgren (NRL), and S. Sallmen (UC Berkeley)

Tucson

As the telescope was brought on-line after its summer shutdown period on September 11, only a few experiments have been completed as of this writing.

Molecular Spectral Line Studies of Comet Hale-Bopp - A number of experiments designed to measure the spectral line emission from Comet Hale-Bopp have been conducted at the 12 Meter during the past several months including a monitoring program to study the changes in the CO emission production rate toward comet C/Hale-Bopp. This program has found that Comet Hale-Bopp (1995 O1) appears to be an object similar to Chiron, yet is presently a long-period comet that has evolved from an Oort cloud quasi-parabolic trajectory. Carbon monoxide is thought to be the dominant outgassing agent in this comet and the group has observed CO via both the J = 1-0 and J = 2-1 transitions. A main goal of this proposal is to measure for the first time the evolution of the production rate of CO with heliocentric distance and to compare it to the rate of water.

Investigators: M. Womack (Penn State), M. Festou (Midi-Pyrenees Obs), J. Mangum, A. Stern (SWRI)

Molecular Line Survey of Methylamine - A survey of methylamine (CH_3NH_2) toward a sample of molecular clouds. The goal of this project is to compare its abundance with that of other CN-based molecules in these regions, which will lead to a better understanding of the chemical processes which lead to or inhibit hydrogenation of molecules in the interstellar medium.

Investigators: J. Dickens (Massachusetts), W. Irvine (Massachusetts), M. Ohishi,(Nobeyama Obs), A. Hjalmarson, (Chalmers, Onsala), M. Ikeda (Nobeyama Obs)

Green Bank

Monitoring at the 140 Foot Telescope of the H_2O maser near the low mass protostar L483 over five years shows a repeating characteristic spectrum. Maser features occur with predictable regularity at velocities either blueshifted or redshifted by a few km/s relative to low excitation material. Normally, one feature only is present, but at times this feature weakens and fades as a feature of opposite polarity strengthens and dominates the spectrum. A possible model for this behavior is a clumpy rotating disk to explain the six-month observed minimum time scale along with the polarity changes.

Investigators: H.A. Wootten, K. Marvel (OVRO), T. Velusamy (JPL), M. Claussen, and B. Wilking (Univ. of St. Louis)

G. PUBLICATIONS

Attached as Appendix A is a tabulation of all reprints received in the NRAO Charlottesville library authored by NRAO staff or based on observations obtained on NRAO telescopes during the reporting period.

H. CHARLOTTESVILLE ELECTRONICS

Amplifier Development, Design and Production

The following tasks in support of the MAP mission have been accomplished:

- Test set for measurement of 1/f gain fluctuation of wideband InP millimeter-wave amplifiers has been designed, built and tested. The data for gain fluctuation for half of a MAP-like radiometer have been gathered. Further studies concerning different amplifier chain configurations are in progress.

- The dependence of gain and noise performance of a W-band amplifier on ambient temperature and bias has been measured. One W-band pre-prototype MAP amplifier had to be rebuilt and retested. A small manufacturing flaw, leading to the possibility of a very high frequency parasitic oscillation at very high frequencies (≅ 130 GHz) has been corrected. The repeatability of gain and noise performance in W-band amplifiers built so far is good, both at room and cryogenic temperatures. Repeatability of phase characteristics, important for MAP, will be tested soon.

- Major instruments needed in support of MAP tasks have been researched, designed (if necessary), and orders placed. These include:

  - HP millimeter-wave network analyzer, including necessary accessories

  - West Bond bonder and accessories

  - microscopes and accessories

- W-band noise measurement system
- V-band noise measurement system
- a number of small tools and components needed for laboratory work (meters, tweezers, detectors, absorbers, etc.)

– The Q-band MAP prototype is under development.

– Numerous discussions with NASA/Goddard and Princeton teams concerning radiometer configuration, cryogenically-coolable switches and detectors, size, weight and power requirements of amplifiers, etc. have taken place.

Work continues on the 26-36 GHz prototype amplifier. Oscillation problems related to the use of InP HFET's in the first and second stages of the amplifier have required major circuit redesign. The design and construction of a test fixture for HFET S-parameter evaluation were also necessary.

Superconducting (SIS) Millimeter-Wave Mixer Development

An experimental 250-350 GHz traveling-wave SIS mixer has been designed in collaboration with SAO and UVA. This uses the recently developed UVA edge-junction process to make a long, narrow, SIS junction down which the LO and RF signal propagate as on a lossy transmission line. As the input impedance is essentially real, tuning circuits are not required. Hitherto, the only way to make such narrow junctions was using electron-beam lithography, available only at JPL. The UVA edge-junction process requires only conventional optical lithography and is easy to implement. The first batch of these mixers had a critical current density lower than intended, which shifted the operating band to lower frequency. At 250 GHz the receiver noise temperature was 51 K DSB. This is a very encouraging initial result. It demonstrates that the UVA edge junction technology is able to produce good SIS mixers, and opens the way to making receivers for the 500 and 600 GHz atmospheric windows.

One of the perennial problems of doing accurate SIS mixer measurements is the need for a reliable, static-free, 4 K coaxial switch to allow absolute calibration of the IF stage following the mixer. Commercial coaxial switches generate fast spikes as high as 1 volt when switching, which is deadly to SIS junctions. While our IF band was 1-2 GHz, we used a simple static bleeder circuit added to standard commercial switches. With recent interest in broader IF bands, probably 2-10 GHz for the MMA, we need a static-free switch with a much broader frequency coverage. We have been working with a microwave switch specialist, Novak Corp., to develop such a switch. Initial tests of a prototype static suppressor circuit were successful.

Instrumentation is under construction for testing the experimental 200-300 GHz image separating SIS mixers now being made at JPL.

One of the most time consuming steps in assembling SIS mixers is trimming the individual mixer substrates to fit the individual mixer blocks within 0.0002". We have been using a dicing saw, first to trim the width of the mixer substrates, and then as a surface grinder to thin the substrate (typically to 0.00035"). Considerable time would be saved if mixers could be thinned as a group before being separated. We have been exploring the use of the high-precision surface grinder in the CDL shop for thinning quartz with the necessary tolerance and uniformity of thickness. With proper setup and measurement, this appears to be a practical approach.

Work continues in the CDL lab and shop on components for the new 8-channel 3 mm SIS receiver being constructed in Tucson.

During this quarter we assembled and tested 11 SIS mixers, using chips from four UVA wafers.

Electromagnetic Support

GBT - Far-field patterns of a Q-band (40-52 GHz) feed were measured. This feed, which is a profiled corrugated horn, has excellent pattern symmetry in the principal planes. The copolar pattern has a taper between -12.5 dB and -14.0 dB at the edge of the subreflector between 40 and 49 GHz. The measured input return loss is better than -22 dB.

A preliminary analysis of the effect of secondary feed rotation/precession on the performance of the telescope was carried out. The change in efficiency between cases with polarization in the symmetric plane and that in the asymmetric plane is less than 0.1 percent for frequencies up to 25 GHz. However, change in cross-polarization levels is about 8 dB at 1.4 GHz and is smaller at higher frequencies. Further investigation is required.

VLA - The VLA Upgrade calls for possible larger subreflectors with half angles of 12.6 degrees and 14.1 degrees. Sizes of feeds for these subreflectors were calculated.

A write-up on the 18-26.5 GHz phase shifter was completed.

GBT Spectrometer

An adaptive filter card to be used for Green Bank was built during the last few months. This card will be used with a small antenna array to filter out FM band interference during low frequency observations.

I. GREEN BANK ELECTRONICS

GBT Spectrometer

During the last quarter, system testing of the GBT spectrometer was begun. So far the sampler rack has been populated with all 32 100-MHz samplers and two of the four digital rack quadrants have been tested. Problems encountered so far include data pattern sensitive clock problems on the memory cards and instability in the power supplies due to the fast switching CMOS loads.

The possibility of NRAO supplying GBT-like spectrometer systems or cards for several other instruments (i.e., the 12 Meter Telescope, the JCMT, and a South Korean telescope) has been studied in the last few months.

GBT IF/Converter Racks

The testing of the 1.6 GHz sampler/filter modules is still on hold because of lack of personnel.

The construction of the 100 MHz converter/filter modules is proceeding and should be complete by November 1st.

Fifteen of seventeen 1-8 GHz converter modules have been fully tested, the remaining two await parts.

Extensive research has been done to determine how to fix the GBT IF fiber optic distribution system problems. We have installed polarization maintaining fiber on the 140 Foot Telescope and are just now beginning to evaluate the fibers.

Our best fiber optic receiver is an Ortel 4511 which is no longer manufactured. Ortel at this point has not been very cooperative. We were promised an Ortel 4515A and a 4518A for tests in August, neither have been delivered. We did receive an Ortel 4516 receiver, which turned out to be no better then the worst unit we have evaluated thus far. After speaking with a factory engineer we found out that we could order a 2515A which is a module and part of the 4515A. The delivery time and price are both much less then the 4515A. We are in the process of ordering one off the shelf 2515A and one modified 2515A. The modified 2515A will address what we feel is perhaps the primary polarization problems for these receivers.

GBT Receivers

The L-band feed modifications are now complete and the radome material is presently being installed. It will be tested on the antenna test range later this year. The L-Band OMT modifications are complete.

The four-band prime focus receiver will be installed on the 140 Foot Telescope in November for preliminary tests at 800 MHz.

The design and fabrication drawings for the 910-1230 MHz prime focus receiver ortho-mode transducer (OMT) was completed in May. Because of GBT Cost to Complete issues the fifth band and therefore this OMT have been put on hold indefinitely.

The C-Band receiver is built and awaiting testing. Due to limited staffing very limited progress has been made in this area.

The design of the S-Band receiver is progressing slowly as a background task to all other systems deemed critical to the operation of the GBT.

GBT Servo System

We have been working closely with the Comsat/RSI servo division on the GBT Servo system. We are monitoring their progress, working out technical details and reviewing their test procedures and documentation. Over the past quarter not a lot of progress has taken place due to a turnover of personnel at RSI.

Site Operations

Interferometer Telescopes. Over the past quarter the interferometer telescopes have been out of operation due to lack of funding. At the end of this last quarter we were asked to bring them back into operation for use in NASA-funded programs. A small amount of time was spent attempting to bring this system back into operation. Presently that effort is on hold until the air conditioning system is repaired and the electronics is properly cooled.

Project Phoenix (SETI). The Electronics Division has assisted the SETI Institute in preparing for observations with the 140 Foot Telescope later this year. Technicians helped assemble and test the SETI receiver. The receiver, which was built by the CSIRO, was packaged in an NRAO-standard front end box. Engineers and technicians rebuilt many of the thermoelectric heater/coolers that will be used to control the internal temperature of the box. Engineers and technicians insured that proper connectors for the SETI receiver were available at the 140 Foot.

Site Fiber. Site requirements for optical fiber were consolidated, and new optical fiber cables were purchased. The new fibers will allow monitor, control, and data signals from many of the telescopes on site to be routed to the new extension of the Jansky laboratory. The cables have been installed, and technicians are attaching the appropriate connectors to the many fibers in the cables.

IRIDIUM. The standard 140 Foot L-band receiver was modified to use special front end filters for test observations of the Iridium satellites. (See discussion page 27.)

As usual, maintenance, repair, and installation support was supplied to the 140 Foot, USNO 20 Meter, and the OVLBI earth-station telescopes. This includes electronic maintenance, electronic design projects to assist users for special projects, and cryogenic support for virtually every receiver in Green Bank. In addition we have been preparing for outfitting the new Jansky Lab.

Normal day to day support of UNIX workstations, weather station, time systems, and local area networks are carried out.

J. TUCSON ELECTRONICS

68-115 GHz Receiver

New mixers have been installed in the low frequency pair of this receiver, resulting in appreciably improved performance over the 68-90 GHz band.

8-Beam 220-250 GHz Receiver.

This receiver is now in routine use. Several early operational problems have been identified and solved. This receiver is the ideal candidate for the development of automatic tuning of receivers, and the software to realize this has been developed and implemented. Although all of our receivers are tuned remotely over the computer network at the telescope site (or even tuned over the Internet from our downtown offices), the precise tuning still relies on the telescope operator closing the loop. The receiver characteristics are such that a simple lookup table of tuning parameters is not adequate to ensure optimum performance. With eight receivers to tune, this clearly puts considerable demand on the operator and can lead to inefficiency in the setup time needed for a new observer, even though the individual receiver channels are less complex to tune than our regular single-beam systems. We are currently using the experience gained with automating the 8-feed system to modify the tuning procedure for all receivers on the 12 Meter Telescope.

The 8-Channel, 4-Beam, 3-mm System

A commercially available frequency tripler for the LO has been tested and works well at 4 K. This validates the concept of using coaxial lines to input the LO to the dewar at one third of the LO frequency. The dewar has been built and awaits testing. The design of the basic receiver insert has been completed, and fabrication has begun. A crossed-grid polarization diplexer designed to operate at 4 K has been constructed and tested. The complete receiver system will likely be tested early next year.

Wideband Continuum Receiver

The availability of HEMT amplifiers covering the frequency range from 70 - 90 GHz raises the possibility of building a continuum receiver with a sensitivity of around 50 mJy per root sec; the extraordinarily high sensitivity comes from the very wide bandwidths. The major problem to be overcome is the 1/f noise which has been reported from early experiments. Although not necessarily worse in this system than in other HEMT amplifiers, the extremely large (bandwidth times integration time) product means that much lower levels of 1/f gain modulation can dominate the residual noise in the detected output from the receiver. Progress with this project is dependent on available manpower.

New Phase Lock Control

One of the most efficient observing modes, generally applicable to relatively narrow bandwidth observations, is frequency switching. Unlike other switching schemes, in this observing mode the object of interest is in the telescope beam and in the spectrometer passband for 100 percent of the time. At present we are limited in our ability to frequency switch, in both switching rate and in total frequency throw, by the analog phase lock system. We have designed and tested a prototype digital phase lock system that combines both frequency and phase control and provides faster, reliable switching over a broader frequency range. Our initial tests with this prototype indicated that we could switch by as much as ± 40 MHz, making frequency switching useable for a wide variety of research projects.

Another capability which will become practical thanks to the enhanced digital phase lock is *sideband smear* operation. This is a powerful technique of reducing confusion in spectral line observations from features appearing in the unwanted sideband. The principles have been established during some *ad hoc* test observations performed at the 12 Meter Telescope, and have been described in conference proceedings. The practical implementation of a usable system at the 12 Meter has been hampered by the performance of the phase lock system; fast switching times over a relatively large bandwidth are required. The digital phase lock should solve these problems.

Cryogenics

All receivers on the 12 Meter Telescope rely heavily on reliable operation of cryogenic systems. A new cryogenic compressor system has been developed for our closed-cycle 4 K refrigerator. The individual compressor units for the Gifford-McMahon refrigerator and the Joule Thomson expansion valve have been combined into a single unit, resulting in a smaller installation with lower power consumption. All four of these units have been fabricated and tested and will be installed on the telescope in the coming months.

Quadrant Detector and Thermal Sensors

One of the main contributions to pointing changes on the 12 Meter Telescope is lateral movement of the subreflector, with respect to the main telescope surface. This is caused by unbalanced thermal effects on the subreflector support structure. We have installed a system on the 12 Meter to sense these changes; we have a laser quadrant detector to measure the lateral motion of the subreflector mount, with respect to the telescope central hub structure, and we have thermistors continuously monitoring the temperature of the feed legs and other parts of the telescope structure. We are currently trying to build up statistics to enable us to understand the detailed relationship between the thermal distribution of the telescope and telescope pointing offsets. At a later date we hope to incorporate the thermal data into our telescope pointing model to give real time pointing corrections.

Major Improvements Completed During Summer Shutdown Period

During the 1996 summer shutdown period, the following improvements were made to the 12 Meter system:

(1) New central tertiary mirror mount. A more powerful drive system which is under computer control has been installed. This will shorten the time to switch from one receiver to another to less than 15 seconds, which will allow easier cross-correlation between pointing with the various 12 Meter receivers. For example, we are investigating the possibility of using pointing measurements at 3 mm to predict the pointing offsets for the 1 mm systems. This new mirror mount will also be equipped with a cold-load system which we will use to conduct more accurate receiver tuning and monitoring of the receiver temperatures.

(2) Hardware upgrade to the 8-channel IF system. The 8-channel continuum receiver system was completely rebuilt. Programmable coaxial IF attenuators now make possible computer control of the total power and spectrometer signal levels. Other modifications make the continuum system easier to monitor and compact in size. Frequency-agile LO synthesizers were installed in the downconverter modules. The 10 to 18 GHz synthesizers are fully computer controlled and monitored and can be adjusted to downconvert any existing IF signals from the front ends. These modifications will make automatic control and monitoring of the IF system possible and will allow for a more efficient computer-controlled receiver tuning.

(3) Improved 258-295 GHz receiver performance. A modification to the receiver optics has lead to a 20 percent improvement in the single-sideband receiver noise temperature for this system.

(4) Upgraded telescope monitor and control. The operator's interface was rewritten in Xlib, making the interface faster. The operator now uses a pure X11R5 windowing system making it standard and consistent with most of the other systems in use at the telescope. Improvements to the planet/comet ephemeris loading were also made, making it easier to use.

(5) New axial focus servo. Several improvements to the focus servo and brake control have been made to allow more accurate control of the radial focus. This will allow a more accurate setting of the radial focus and should find use in the damping of standing waves encountered during frequency switched measurements.

K. SOCORRO ELECTRONICS

VLA L-band Image and 1400 MHz Birdie

Microstrip prototypes of the new Walsh function phase switching scheme in the 200 MHz output of the L2 first local oscillator did not remove all the out-of-band signals which are imaged to appear in-band; nor did they greatly reduce the 1400 MHz spurious signal in L-band. Investigations indicated isolation amplifiers would be required to reduce the effect of load pulling on the phase shift accuracy. We evaluated isolated prototypes on five antennas and they performed well. Installation on the remaining antennas should be completed by January 1997. That should eliminate the image of 1533-1535 geostationary satellite emissions which have badly interfered with 1665-1667 MHz mainline OH observations.

A number of F12 12-15 GHz converters excessively leak the 1400 MHz harmonic of 200 MHz, so all modules will be retrofitted with new RFI suppressed phase detectors. Currently 15 antennas are modified and all antennas should be outfitted by January.

VLA Upgrade Prototype: K-Band Front End

Development work continued slowly on a front end covering in the frequency range of 18 GHz to 26. 5 GHz. The Central Development Lab completed a prototype polarizer consisting of a waveguide phase shift section and an OMT section. The phase shifter will be improved. Most components for two front ends are on hand. Dewar design and fabrication will occur next quarter. Assembly will start late in the first quarter of 1997. One front end will include three sub-band total power system-temperature monitors for estimating atmospheric phase variations.

VLA Upgrade Prototype: F14 Module

Three new F14 modules with front panel cyro controls and analog monitoring will be built for the K-band front end project. The target for completion is November 1996.

VLA, VLBI, and Pulsar Improvements

A major improvement for the VLBI and Pulsar back-ends began this quarter with development of detailed project plans for design and construction. Some construction also began this quarter. An analog-sum buffer for the four IF outputs from the correlator will isolate the new VLBI Switch and the new Pulsar Patch Panel. It will include local display and computer monitoring of power levels. It also will equalize the frequency response to flatten the passband over 1-45 MHz.

A VLBI Baseband Switch will connect any of 16 inputs to each of the four VLBI IF inputs which up convert to 600 MHz VLBA IF inputs. Four inputs will be from the analog-sums and 12 inputs will be grouped as four IFs from one antenna each on the west, north and east arms. Switch control will be manual and by online computer. Front panel displays will indicate connection paths.

A new patch panel will connect the four IF outputs from the analog-sum buffer to the 2-channel 150 MHz upconverter for the 14-channel video converter pulsar system and to the pulsar wideband detectors.

A 32-channel baseband level-setting system will maintain ideal signal levels out of the High Time Resolution Processor (HTRP) Multiplying Polarimeter. The HTRP PC will set the levels as well as acquire the high speed data samples.

Design continues on a VME Timing Card that generates and controls the sampling, correlator gating, time-of-day clock, and other functions of current and future general purpose pulsar data acquisition systems in a flexible and extensible manner.

VLA Correlator Controller

The project plan was revised again. Work in hardware continues, but software slowed because of little available programmer time. The serial I/O subsystems will be tested next quarter. The data link will be tested during the second quarter of 1997.

VLA Antenna B-Rack Shields and Optical Fibers

Twenty-eight shields with optical fibers have been installed in antennas. However, tests indicated shielding effectiveness is about 15 dB at P-band instead of the expected 35 dB. A New Mexico Tech student located and corrected leakage paths in a spare shield. As a test for leakage paths for all the seams and openings were covered with tape with conductive adhesive. This test indicated no leakage paths. The laboratory test indicated that the shielding effectiveness at P-band (300 MHz) is about the expected 35 dB and L-Band 1000 MHz is about 30 dB. The test that initiated these efforts was conducted in an antenna by removing the front access panel and replacing the panel and noting the difference on a spectrum analyzer. This test was repeated in the lab with the same results, which indicated that the shielding effectiveness of the front access panel is 15 dB. Testing will continue to further improve this shield.

VLA Virtual Instrument Recorder (VIR)

This system replaces the eight-channel Digital Data Tap which uses an eight-channel Analog Recorder. All hardware and software to provide the AOC access to on-line VLA site monitoring and data recording using a graphical interface was completed. The system provides simultaneous multichannel and multiuser capability. Software development for long term data logging continues.

VLA 74 MHz Simple Receiver

We have started a conceptual design of a simple and cheap singly polarized 74 MHz receiver which could complete the addition of this band to all antennas.

VLA Atmospheric Phase Monitor

The Mauna Kea site testing interferometer was disassembled in August and the antennas shipped to the VLA and the receivers to Tucson for testing and improvements. The entire system will be installed at the VLA next quarter as a near-real-time atmospheric phase monitor.

Cryogenics

We have used a variable-speed motor controller to investigate the effects of reduced-speed operation on a CTI 350 refrigerator. The refrigerator operates smoothly to 25 Hz with the controller feeding a Scott T transformer arrangement. Tests of load capacity vs speed will be done.

GPS Receivers

The Radiocode (U.K.) GPS receiver, which is nearly compatible with the VLBA Odetics 325 receivers, was returned from Radiocode after repair of an operational defect. The receiver was installed at the VLA VLBI system and has operated satisfactorily for two months.

VLBA Masers

The falling IF level in maser #11 appears to have been caused by aging of a non-NPO monolithic capacitor used in a narrow bandwidth tuned circuit. The IF stage was retuned with NPO capacitors and maintained good level stability for 6 weeks. Maser #11 replaced maser #8 at North Liberty which had an internal power supply failure in August. Maser #8 was repaired at the AOC and is being evaluated.

VLBA IF Equalizing Amplifiers

Early this year we discovered a fabrication defect in most of the IF gain equalizing amplifiers which degraded their gain compression level by about 5 dB. All VLBA sites were tested and corrected.

VLBA M105 D-Rack Interface Module

Testing of sixteen modules resulted in a modification. All VLBA antennas now have the module installed.

VLBA Prototype 3-mm Receiver

The Central Development Lab has assembled a prototype 80-90 GHz receiver. It was tested for fit and mounting in the Pie Town antenna. Following installation of the second LNA and lab tests, it will be installed in VLBA-PT for operational and performance tests in December. A second receiver will be installed at Los Alamos in 1997.

VLBA Correlator

We continue to experience no failures from the batch of 1000 new ASICs installed in the FFT cards. Three old ASICs have failed in the third quarter (as of Sept. 23).

The VLBA Correlator hardware now has been included in the MAINT database system.

We are studying a problem in which fringes are disrupted due to a loss of sync in the Playback Interface. It appears that poor playback might induce the lost sync. We need to identify mechanisms that might cause the lost sync and see if we can prevent the lost syncs from occurring. The lost sync condition is where the deformatter card misses one or more 4 msec interrupts. This causes the tracking of the delay model to be wrong until the next model update. We continue to work on implementing a self test that provides a test of the FFT and MAC portions of the correlator while observing is in progress. Recent tests indicate that we are able to inject the test cycle without disturbing the observation, but more work is required before we declare self test to be ready for integration into the observing system.

Work has begun on a correlator overview manual. This introductory manual will be followed by detailed manuals for each sub-system in the correlator.

VLBA Data Acquisition and Playback

Work on high density recording and playback continues. The system is more sensitive to record write voltages, which have been adjusted at the stations. We have noticed some effect of thick tape changing the contour of the heads. Thick tape vacuum was increased in the playback drives. Oscillations in the reproduce system were greatly reduced by modifying all of the Parallel Reproduce Modules to improve grounding. Study of signal-to-noise ratios and spectral performance of all playback drives continues. We discovered and fixed a number of problems with head amplifier circuits. Development began on a test jig to test head assemblies in the lab before headstacks are plugged in. Engineering Services has delivered a prototype heater assembly for further testing of reduction of relative humidity in the headstack area.

Interference Protection

The low-sensitivity survey of the VLA spectral environment from 70 to 1000 MHz was completed without contamination by emissions from the controller PC, which was successfully shielded. A New Mexico Tech student continues to develop software to display the data and derive useful statistics.

The W8 P and L band monitor at the VLA measured signal activity in L band at the D-array Sky survey frequencies of 1340 - 1390 MHz and 1410 - 1460 MHz. Frequent intermittent interference was identified at 1381 MHz as originating from the GPS-L3 satellite transmitters. The NSF Spectrum Manager contacted the Air Force, which reduced the L3 activity when reminded of their MOU with NRAO. Additional impact of RFI on the survey was activity in the 1350 - 1400 MHz during daytime hours from White Sands Missile Range activities. The spectrum analyzer in the W8 monitor is controlled from the AOC and dumps peak and average spectra to the AOC at 15 minute intervals. New software now produces gray scale plots of spectra vs time for 24 hour periods.

The digital auto-correlator spectrometer will initially be used as one of the back-ends for the IRIDIUM tests. Later, we will monitor the 4 baseband IFs of the antenna at W8. Eventually a frequency down converter will allow the auto-correlator to replace the spectrum analyzer in the W8 P and L band RFI monitor.

IRIDIUM Satellite Tests

The 1994 MOU between NRAO and Motorola Satellite Communications, Inc., requires cooperative work on a test program to determine the IRIDIUM satellite system signal levels at the Observatory sites. Motorola agreed not to exceed a spectral power flux density (SPFD) of -223 dB(W/m^2/Hz) at the VLA at all times. Tests on the first three IRIDIUM satellites in orbit will occur in January - February 1997. VLA test objectives are to measure A) the impact of IRIDIUM emissions on VLA observations of 1612 MHz OH, and B) the SPFD of IRIDIUM emissions in the 1610.6 - 1613.8 MHz radio astronomy band.

Our test plan for objective A) calls for measurements with two subarrays, three antennas with special 1612 MHz bandpass filters to minimize gain compression from the satellite's main emissions at 1621.35 - 1626.50 MHz and 24 antennas in normal mode to determine the effects of gain compression.

Tests for objective B) will use the antenna at W8 with a modified L-band front end, a direct coax connection from front end to test back-ends in the control building. Test back-ends will include a digital spectrometer, the pulsar HTRP and the VLBI data acquisition systems. Spectral differencing synchronous with the IRIDIUM transmission on/off cycle will remove GLONASS satellite emissions.

A bandpass filter for the 1612 MHz RA band was successfully retuned and cooled, which will allow it to be used inside the W8 antenna L-band dewar for IRIDIUM testing. Cooled switches will bypass it for normal operation. Normal unfiltered cryo amplifier configuration could gain compress sufficiently to impair satellite spurious emission measurements when the satellite is in the VLA main beam.

Parts have been ordered to build a signal source emulating the IRIDIUM satellite's multichannel emissions. This will allow us to determine intermodulation levels within our own equipment.

L. COMPUTING AND AIPS

General

The most critical issue facing computing at the NRAO is the steady aging of the Observatory's computing infrastructure in the face of increasing demand. The constrained budgets faced by the observatory are forcing a strategy of neglect onto computing. The current low spending levels for computing will not sustain the NRAO's ability to remain a world class research organization.

The obsolescence of the standard workstations which most scientists and engineers have at NRAO is obvious when those machines are compared to what is now available from the consumer market. The usual IPX or IPC machines which NRAO staff have on their desks run AIPS more slowly than an under $2000 PC running AIPS and Linux. The performance of our high end workstations (except for the Dec Alpha in CV and the Sparc Ultra in Socorro) is basically equaled by medium high end PC's in the ~$5,000 price range. The workstations (PC's) we are buying for secretaries out-perform our standard issue scientific workstations by a factor of 2 to 4.

1996 RE Budget

The RE budget improved dramatically this quarter, allowing some efforts to keep the computing infrastructure at NRAO from accelerating in its decline. An allocation of $117,000 was dedicated for computing Research Equipment, and operational funds were available to address critical computer networking needs in Socorro and Green Bank. These combined with support received from NASA, will allow vitally needed public workstations to be purchased. There will be a major workstation purchased at each of NRAO's principal sites, plus two smaller workstations for the AOC. These purchases will help address the needs our users and visitors face for computing, but the outstanding problem of the aging machines most staff members are using continues to grow more critical.

NRAO Intranet

NRAO is now committed to the creation of a dedicated frame-relay network between the NRAO sites, including six of the VLBA stations. This dedicated network, or *Intranet* will provide guaranteed levels of service allowing critical functions to be reliably carried out. Currently, most intersite computer networking traffic relies on the Internet, which is unable to provide the levels of service required. The benefits of the NRAO Intranet will be dramatically improved reliability and higher bandwidth to Green Bank, which currently has only a 56 kbit link to the Internet. NRAO will remain firmly connected to the Internet through one or two gateways, but intersite networking will no longer depend on the Internet. There are some moderate startup costs associated with the Intranet, but estimates are that the operations cost of the NRAO Intranet will be similar to our current Internet connections despite the vast improvement in service levels. We are investigating including NRAO's long distance phone service under a related contract; this could result in dramatic savings (up to 60 percent) for much of NRAO's long-distance voice communications.

Strategic Partnership between NRAO and NCSA

Testing and benchmarking of the latest version of AIPS at the National Center for Supercomputing Applications (NCSA) has been completed. Although the performance was good, the current inability of AIPS to take advantage of the parallel architecture of the NCSA machines means that there is not a great advantage for current AIPS users to use the AIPS installation at NCSA. Some background work will continue to investigate improving AIPS performance at NCSA (in cooperation with interested third parties), but these efforts are severely limited by lack of available staff to do the work.

In contrast to the disappointing results for the AIPS testing, the use of NCSA facilities for structural calculations related to the GBT has been extremely successful. There is approximately a 50-fold improvement in performance using the NCSA facilities compared to locally available workstations, enabling important dynamical calculations of the performance of the GBT structure.

ADASS '96: Sixth Annual Conference on Astronomical Data Analysis Software and Systems

NRAO was host for the Sixth Annual Conference on Astronomical Data Analysis Software and Systems (ADASS '96). ADASS is an international conference which provides a forum for scientists and programmers concerned with algorithms, software, and software systems employed in the reduction and analysis of astronomical data. Over 250 participants attended, making this the largest meeting NRAO has hosted in Charlottesville in at least a decade.

The ADASS conference ran extremely smoothly, due to the hard work and dedication of computer division staff and the Director's Office. ADASS is more complex to set up and run than most conferences its size because of the requirement for numerous computer demonstrations and e-mail terminals in addition to the conventional oral and poster sessions. For the meeting, a network of 21 workstations was set up and connected to the Internet through a dedicated ISDN link, successfully providing the services needed by Conference attendees.

Another important component of the success of ADASS was the financial support the Conference received from numerous sources. A contribution was received from the National Science Foundation, in a special supplement to NRAO's budget from discretionary funds at the foundation. NRAO and the ADASS Conference are grateful for the Foundations's support.

AIPS Software

A large scale clean-up of unused or oversized buffers in February and March had caused several tasks to fail. After a prolonged effort, now all tasks affected are back in working order, with the additional advantage of smaller memory requirements.

Most of the effort went into further debugging of VLBA and VSOP related software, and into adding new functionalities to these tasks. A few illustrative examples:

1. VPLOT. The possibility of specifying the subarray was added; SUBARRAY = 0 defaults to plotting all subarrays. VPLOT can plot a model based on a configuration with one or several VLBI antennas in orbit. It now also can plot a model based on many fields (up to 16), e.g. resulting from a multi-field clean.

2. PCCOR. It now supports multiple subarrays, with SUBARRAY=0 defaulting to all subarrays. The new adverb CUTOFF allows to switch off the cable delay, which is useful for geodesy applications.

3. APCAL. GAIN (GC) table buffers were increased to 16384 to accommodate Mark-3 datasets with 28 IF channels, null characters were stripped from antenna names to increase the robustness of the calls to the KEYIN routines, and handling of source selection of the type "-SOURCE" was improved.

4. CALIB. An error in the way CALIB dealt with dual polarization data was corrected. It sometimes occurred when one polarization was missing throughout a solution interval. In the fit, polarization-independent weights were used, which at times led to very high gains in the missing sense of polarization. This in turn biased the mean gain modulus (MGM), if computed. Errors in the MGM were cumulative over several iterations.

5. BLING. It is now possible to divide a model into the data before searching fringes and can use the Schwab-Cotton FFT algorithm to add in data from indirect baselines for greater sensitivity. Off-center window handling has been changed allowing greater padding to be used in the FFTs: this has removed the need to refine fringe positions using non-linear least squares. This has also greatly decreased the chances of obtaining wild solutions. The Mark-3 mode search was modified to look for multi-band delay and rate before single-band delay, which should improve BLING's chances of finding some fringes in this search mode.

6. BLAPP. Added missing tests for bad BLING solutions in the input. Without these tests divide-by-zero errors were almost guaranteed since the acceleration error is set to zero when acceleration is not solved for. This was not discovered earlier since BLAPP worked fine under the Solaris operating system. Another modification deals with the misaligned time-stamps for different baselines that will arise if different solution intervals are used on different baselines.

7. SNCOR. Two new features were added: 1) OPCODE='PCOP' allows solutions to be copied from one polarization to another with the copy direction controlled by SNCORPRM(1); 2) OPCODE='PNEG' will flip the sign of the gain phase for all selected solutions. Both features are sometimes required in line polarization calibration. Also added the capability of SNCOR to work on single source files.

8. USUBA. A major re-write of this task was prompted primarily to accommodate the new subarray features allowed by the VLBA correlator. The task now works in three possible modes: i) automatic subarray identification; in this case an

algorithm is used which minimizes the total number of subarrays and maximizes subarray continuity; ii) multiple subarray definition in an external text file; and iii) selection of an individual subarray through the input adverbs.

VLBA Specific Developments

Work continued on the VLBA DDT. This is a sequence of tasks to mimic a typical VLBA data reduction session. The purpose of this is twofold: i) it compares the outcome with the results of an earlier standard-run, and as such measures the effects caused by intermediate software changes, ii) it serves as a benchmark, useful to test the actual AIPS speed of workstations during a typical VLBA session. This is a welcome addition to the existing VLA DDT.

The error analysis in the image fitting routines was completely overhauled; these tasks now yield a far better error estimate.

General Developments

A new task was written that reads GPS ionospheric data from an ASCII file and writes it to the newly created table type GP attached to a uv data file. This table is used by the other new task GPSDL; it fits a simple, local model of the ionosphere to GPS data loaded by LDGPS and uses this model to correct phases for the excess path in the ionosphere and to calculate ionospheric Faraday rotation.

The experimental pseudoverb XHELP was added to AIPS. It provides direct access to HTML versions of cookbook-level help. When invoked, it will automatically start a Netscape process (if not already running) and loads the specified HTML file.

Personnel

The AIPS group has lost two FTE's alone in the current year. The five FTE's that are left share the responsibility for i) AIPS local and global system support, including adapting AIPS for new architectures and more recent versions of operating systems, ii) AIPS application software user support, iii) management of AIPS releases and shipping requests, iv) development of new software, especially to support new instruments (VSOP). Bug-fixing has not received quite the attention that it should have, and if AIPS is to maintain its good level of robustness of the past years, the AIPS group would need at least one of the two lost positions back.

M. AIPS++

In the third quarter of 1996, AIPS++ worked on the following principal targets:

- Beta and first releases of AIPS++ for January and July 1997. Details of the contents of the release may be found at http://aips2.nrao.edu/aips++/docs/project/beta/beta.html.

- Design and implementation of a single dish calculator, SDCalc, for analysis of single dish spectral data. This is one of the products needed by the GBT project for the commissioning of the GBT.

- Support of the use of AIPS++ as the primary data reduction path for the new WSRT on-line system, the Telescope Management System (TMS). TMS will be turned on in November.

- Support of the use of AIPS++ in a scientific project being undertaken at the Parkes Telescope to survey extragalactic HI emission in the Southern Sky.

In addition, we developed new interfaces to the synthesis calibration and imaging capabilities, and started alpha testing. We adopted the Free Software Foundation GNU project C++ compiler as the standard compiler under which all AIPS++ code must run. We made numerous improvements to various parts of the AIPS++ library such as the Table system and the fitting classes. We prototyped a complete, integrated help system for end-users of AIPS++, and we finished an update of the Programmer's reference manual.

N. GREEN BANK TELESCOPE PROJECT

Antenna

The 140x163x40 foot deep elevation box structure, which one year ago was only half trial-erected, is now completely assembled and installed on the structure and 99 percent welded. The box structure will act as the support for the reflector backup structure, feed arm and elevation wheel. Its completion is a major project milestone.

The elevation wheel is complete. The counterweight boxes have been installed and will be filled with concrete in a pre-determined order to keep the antenna balanced and *tail heavy* as the structure grows. The elevation drive assembly is approximately 90 percent complete.

The top 60 feet of the upper vertical feed arm have been completely trial erected at Green Bank. This assembly will be used for final setting of the subreflector surface and testing and calibrating all mechanical elements on the feed arm including the prime focus boom, the prime focus feed rotation mount (FRM), the subreflector adjustment mechanism, the turret in the feed/receiver room, and the entire feed arm servo. If possible, the entire assembly will be installed as a unit on the antenna following this extensive testing.

The subreflector back-up structure is completely assembled and is at the site awaiting installation of the subreflector panels. The panels have been manufactured, tested, accepted, and painted have met the specified tolerances. They were shipped to the site the first week in October.

In addition, the feed/receiver room, including the installation of the interior walls insulation and the feed turret has been completed.

The completed backup structure (BUS) will contain 7,625 pieces. Of those, 6,593 pieces have been fabricated and shipped to the site, and approximately 3,000 pieces are already in place. At this writing, the BUS trial erection is continuing and trusses 19L through 19R are in place and aligned on the erection pad. The BUS is divided into 22 modules (1L through 11L and 1R through 11R) for assembly purposes; of those, the inner five are already completely welded. Following completion of the trial erection and installation of the horizontal and lower vertical feed arms, the BUS will be disassembled into its 22 modules and lifted into place on the antenna.

The 2,200 main reflector panels, currently in production and painting at the Contractor's plant, are scheduled to be shipped to Green Bank between January and June 1997 and installed on the BUS in late 1997. Final antenna delivery and acceptance are currently scheduled for December 1997. NRAO is encouraging the Contractor to explore every possible way to maintain this demanding schedule.

Active Surface

Coding of the power-up self-test continued: a function to evaluate the "complex status data" retrieved by the master computer from the slaves was completed and tested; a function, which tests the positions read back from all actuators and logs errors if the positions are out of range, was coded and tested. Some tests of the interface to the pointing control computer were successfully conducted.

Manufacturing of actuator cables by a subcontractor has begun. NRAO has evaluated two of the first ten first-article cables. Construction of the cables appeared to be of high quality. One of the cables was also tested with the NRAO designed cable test system and with the actuator control system itself.

Three aspects of the software development were worked on this period. The first was the interface with the software which commands the active surface. The interface command, which sends an array of actuator commands to the active surface master computer, was successfully tested. The second aspect included bug fixes to the active surface side of the above interface. The final aspect was the continuing development of the initialization software. The motor power supplies are heavily interlocked; for instance, run-away actuators, unresponsive slave processors, and a faulty master oscillator all prevent power up of one or more supplies. In order to encapsulate these design decisions, and facilitate re-use later in the program, a supply control class was written. The class has been tested for all motor supplies. Control of the transnet supplies has also been incorporated into this class but this code still requires testing.

Servo

A review of servo test points provided by the Contractor has been conducted. Also, recommendations of servo test points that should be actively monitored were solicited and reviewed.

Metrology

140 Foot Telescope Demonstration. A GBT memo has been issued on the status of the 140 Foot Telescope demonstration.

Production. 1500 of the 2,209 retroreflectors have been mounted and the calibration numbers have been entered into a spreadsheet. Production of the final nine University of Arizona spherical retroreflectors is running slightly behind schedule.

Software. Great progress has been made in software development during this period. Data from the prototype ZIY is now directly placed in an Excel spreadsheet, through the OLE interface, and plots of amplitude, phase, and distance are now available in real time on the ZIY screen.

The first demonstration of getting actual weather data from the monitor and control system via a remote procedure call has been achieved. A weather screen will be included in the ZIY, and the group refractive index will be calculated

A preliminary drawing of the laser metrology block diagram has been distributed for comment.

GBT Architecture. A GBT Memo has been issued on the laser Nominal Hazard Zone (NHZ), and a preliminary site drawing has been released for comment. Work has started on the error analysis for various configurations of retroreflector locations.

Work continues on the Star*Net analysis of the GBT architecture and error analysis. Detailed definition of each local coordinate system, including the FEA model transformation equations, is being documented in order to establish agreement on mechanical interface points between the laser metrology system and calibrations within the local rigid frame.

Electronics

GBT Prime Focus Receiver. Wiring and cabling of the front end box was completed. PC cards were installed in the card cage, and the dewar assembly was reassembled. The dewar assembly was re-installed in the front end box and re-cabled to the rest of the system. The feed was installed, and the receiver was cooled and installed in the indoor/outdoor test building for noise temperature measurements.

Noise temperature measurements were made on both X and Y channels of band #1 using the cold sky/ room temperature absorber method. Measurements at RF indicated that Y channel is performing as expected, with a noise temperature of about 16 K at the center of the band, and about 24 K at the edges of the band. However, X channel was about 10 K higher. It was found that the gate voltages of one of the X channel HEMT amps was abnormal, which means the dewar will probably have to be re-opened to correct the problem.

Noise temperature measurements were made through the entire front end, including the IF system. Initially, abnormally high values were obtained, but this was the result of overdriving the mixer with the RF signal. Re-adjusting the level at the mixer input gave noise temperature values measured at IF identical to those measured at RF. Component layout of the Mixer/IF Switch Filter Module is now being altered to permit easy adjustment of the RF level at the mixers inputs.

IF/LO System. Components for a second noise source module have been ordered. The metal work is now being fabricated in the shop.

Orders are currently being placed for the electrical components needed to build the remaining GBT modules and spares for the LO Reference distribution system.

During the period, testing of the 1-8 GHz converter modules continued. Fifteen units are now complete with two units awaiting parts and final testing.

Construction of sixteen 100 MHz Converter Filter modules was started in August. Construction should be complete by the end of October but testing will be put on hold until after the beginning of 1997 due to the lack of available manpower.

Testing of nine 100 GHz Sampler Filter modules are on hold until after the beginning of 1997 for the same reason.

Fiber Optics. The PM fibers were installed on the 140 Foot Telescope. Preliminary tests indicated the sensitivity to the vibrations of the transmitter, PZ fiber interface. The optics were enclosed in a wooden box for temperature and mechanical stability which improved the sensitivity; however, difficulties were found in obtaining quantitative results with people and equipment being moved at the 140 Foot. Plans are for testing after hours when telescope time is available.

An Ortel DFB laser transmitter and a 20 GHz receiver arrived on loan as demo units. The receiver was tested and was found to have unacceptable polarization sensitivity. Ortel was contacted and made aware of the findings. The emphasis is now on obtaining a 10 GHz 4515A unit to test.

The transmitter internal isolators were found to be adequate enough to be used with PM fiber without any extra isolation.

Switching Signals. This month the Selector/Distributor has been tested. We are now running the entire system to get an idea of how many errors occur on the multiplexed signals. These multiplexed signals are updated every 200 nano sec.

The Cal-S/R buffer chassis remains in the shop awaiting construction. The printed circuits for this chassis are in the process of being constructed.

Weather Station. The MCB interface to the new weather station (WT2) was checked on the bench. The actual installation at the tower will be made when the software is ready.

L-Band Receiver. New probes with tuning elements were completed by the shop. The OMT now meets all of the electrical requirements at room temperature. The new probes were removed and sent to Charlottesville for gold plating.

The waveguide thermal transition was tested this quarter. The test results looked good.

The GBT L-Band dewar was assembled, less internal parts, and vacuum tested for several days. A number of purges using heated nitrogen were performed with good vacuum results.

S-Band Receiver. The cryogenic isolators were reworked by Channel Microwave and sent back to Green Bank. They were forwarded in mid-September for testing in Charlottesville.

C-Band Receiver. The C-band receiver was moved over to the receiver test area and cooled in preparation for noise temperature measurements.

Cryogenics. Major piping and the bulkhead were installed in the compressor room.

Monitor and Control

Work on implementation of LO1A and of the IF Manager, whose functionality includes the Observing Frequency Formula specification, continued during this period. The IF Manager is on schedule and the LO1A is close to schedule.

From the analysis of the data from the three-day all-sky survey the previous month, enough data was obtained from observing to complete the initial two phases of the holography experiment, i.e., 1) pointing accuracy and repeatability, and 2) large-scale pointing accuracy.

Work picked up again on the prime focus receiver 1 which was waiting for hardware to be assembled.

The antenna software was enhanced to allow the simulation of control of all of the axes for use in the lab mockup. Work continued on the final revisions of the antenna interface definition documents for the pointing system and the single-board computer remote reset system. The calculation of structural model displacements with respect to the optical axis and focal point of the best-fitting-paraboloid was completely rewritten to correct errors in the 1995 version. Code to utilize this algorithm in the open-loop surface servo was completed. The structural model and these algorithms were integrated into a client program which communicates with the actuator control server to set the 2209 actuators of the surface for a specified elevation.

A new version of the production software, version 2.3, was released at the 140 Foot Telescope. This release includes a restart option to TaskMaster, fast monitor console components, use of Solaris 2.5, dynamic lining of VxWorks libraries, and a new library for writing FITS files.

The rewrite of the monitor software for improving reliability and providing indicators for warnings or error conditions began at the beginning of the month and is progressing ahead of schedule.

Data Analysis

The prototype version of SDCalc, which can do simple spectral averages with data selection, and the "results box" described in the previous progress report is now working. The SDCalc group within AIPS++ is refining the averager prototype and working on the next phase which will be to add polynomial and sinusoidal fitting. The current goal is to have an alpha version of a few components of SDCalc available for some select users outside of AIPS++ in November.

The public release of Glish version 2.6 has been delayed until late October. This version of Glish is currently in use within AIPS++. In addition to a number of bug fixes and minor enhancements, this version will use shared libraries and shared memory. It also will have an improved error handling mechanism. These last two improvements (shared memory and error handling) are a response to the comments we received after tests using AIPS++ last July and August.

Work began in late August on a Glish/Tk interface to the PGPLOT library. This will allow us to build complex and flexible plotting tools using PGPLOT and written in Glish. This work is being done by Yanti Miao at NCSA.

Comments have also lead to an improvement in the execution speed of Gaussian fitting. The 2-dimensional fitter is now comparable to the speed of the equivalent fitter in classic AIPS and the 1-dimensional fitter should also be fast enough. The current limitation for small data sets is the speed of Glish events. The addition of shared memory in Glish should help.

The Green Bank installation of AIPS++ is now compiled with the GNU suite of compilers. AIPS++ no longer supports CFRONT-based compilers with the exception of Glish. AIPS++ will continue to support Glish compilation using CFRONT-based compilers for the foreseeable future.

A prototype single dish FITS writer from an AIPS++ MeasurementSet is working. The reader, which would convert single dish FITS to an AIPS++ MeasurementSet, will not be available until later this fall.

O. PERSONNEL

New Hires

A. Mioduszewski	Assistant Scientist	08/15/96
D. Thacker	Electronics Engineer	09/16/96
J. Ulvestad	Associate Scientist	08/19/96
L. van Zee	Research Associate	08/26/96
J. Webber	Assistant Director - Central Development Lab	07/08/96

Terminations

D. Adler	Assistant Scientist-Research Support	08/30/96
P. Green	Systems Analyst	07/25/96
P. Jackson	Sr Administrative Assistant	08/30/96
A. Lobanov	Junior Research Associate	07/19/96
J. Navarro	Research Associate	07/26/96
D. Nice	Research Associate	07/31/96

Other		
T. Bastian	Leave for Professional Advancement	08/12/96
K. Desai	Transferred from Charlottesville to Socorro	08/01/96
E. Fomalont	Leave for Professional Advancement	07/01/96
Change in Title		
C. Janes	to Head/VLA Engineering Services	08/01/96
J. Ruff	to Mechanical Engineer	08/12/96
L. Serna	to Deputy Head Engineering Services	08/01/96

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